CLAIMS:

1. A method of preparing a cast composite material, comprising the steps of: providing an aluminum-based matrix alloy; preparing a mixture of from about 10 to about 40 volume percent of free-flowing boron carbide particles and from about 90 to about 60 volume percent of a melt of said aluminum-based matrix alloy; stirring the molten mixture to wet the matrix alloy to the boron carbide particles and to distribute the particles throughout the volume of the melt; and casting the molten mixture;

characterized by maintaining the fluidity of the molten mixture by (a) maintaining the magnesium content of the matrix metal below about 0.2% by weight, or (b) starting with a matrix metal containing less than 0.2% by weight magnesium and adding further magnesium to the mixture a short time before casting, or (c) having at least 0.2% by weight titanium present in the mixture.

2. A method according to claim 1, characterized in that the when the fluidity is controlled by maintaining the magnesium content of the matrix metal below 0.2% by weight, the boron carbide is within the range 10 to 25 volume percent.

3. A method according to Claim 2, characterized in that the magnesium content is less than 0.1% by weight.

4. A method according to Claim 3, characterized in that the magnesium content is less than 0.05% by weight.

5. A method according to any one of Claims 2 to 4, characterized in that the boron carbide is within the range 15 to 20 volume percent.

6. A method according to any one of Claims 2 to 5, characterized in that the matrix alloy is either an AA1000 type alloy or the matrix alloy is an aluminum alloy comprising 5 to 10 % by weight Si.

7. A method according to Claim 1, characterized in that when the fluidity is controlled by starting with a matrix metal containing less than 0.2% by weight magnesium and adding further magnesium to the mixture a short time before casting, the boron carbide is within the range 10 to 25 volume percent

8. A method according to Claim 7, characterized in that magnesium is added to the molten composite to raise the magnesium concentration in the aluminum matrix alloy to between 0.2% and 0.8% by weight and the molten mixture is cast within 20 minutes of adding the magnesium.

9. A method according to Claim 7, characterized in that the further magnesium is added in a casting trough or in a transfer ladle.

10. A method according to any one of Claims 7 to 9, characterized in that the composite is further stirred after the addition of the magnesium

11. A method according to any one of Claims 7 to 10, characterized in that the aluminum alloy is

selected from the group consisting of AA2xxx, AA3xxx, AA4xxx, AA6xxx, AA2xx or AA3xx alloys.

12. A method according to Claim 1, characterized in that when the fluidity is controlled by having at least 0.2% by weight titanium in the composite, magnesium is added to the molten composite to raise the magnesium concentration in the aluminum matrix alloy to at least 0.2% by weight and the boron carbide is within the range 10 to 25 volume percent.

13. A method according to Claim 12, characterized in that the molten mixture is cast within 30 minutes of adding the magnesium.

14. A method according to Claim 12, characterized in that the composite contains less than 5% by weight titanium.

15. A method according to any one of Claim 12 to 14, characterized in that the magnesium concentration in the aluminum matrix alloy is no more than 1.4 weight percent.

16. A method according to any one of Claims 12 to 15, characterized in that the aluminum alloy is selected from the group consisting of AA2xxx, AA3xxx, AA4xxx, AA6xxx, AA2xx or AA3xx alloys with added titanium.

17. A method according to Claim 1, characterized in that when the fluidity is controlled by having at least 0.2% by weight titanium in the composite the

aluminum matrix alloy is an AA1xxx alloy with added titanium.

18. A method according to Claim 1, characterized in that the composite contains less than 5% by weight titanium.

19. A method according to any one of claims 1 to 17, characterized in that the cast mixture is remelted and cast into a shape.

20. A method according to any one of claims 1 to 17, characterized that the cast mixture is extruded into a shape.

21. A method according to any one of claims 1 to 17, characterized that the cast mixture is rolled.

22. A method according to any one of claims 1 to 17, characterized that the cast mixture is forged.

23. A method according to any one of claims 1 to 17, characterized that the cast mixture is formed into a neutron absorbing material.

24. A cast composite product comprising an aluminum alloy matrix having between 10 and 40 volume percent of boron carbide refractory particles dispersed therein, said composite containing at least 0.2 weight percent titanium, and the aluminum alloy matrix having an as-cast microstructure.

25. A cast composite product according to Claim 24, wherein the aluminum alloy matrix is an AA1xxx alloy.

26. A cast composite product according to Claim 24, wherein the aluminum alloy matrix contains at least 0.2 weight percent magnesium.

27. A cast composite product according to Claim 24, wherein the aluminum alloy matrix is an AA2xxx, AA3xxx, AA4xxx, AA6xxx, AA2xx or AA3xx alloy.

28. A cast composite product comprising an aluminum alloy matrix having between 10 and 25 volume percent of boron carbide refractory particles dispersed therein, said composite containing at least 0.2 weight percent magnesium, and the aluminum alloy matrix having an as cast microstructure.

29. A cast composite according to Claim 28, wherein the aluminum alloy is an AA2xxx, AA3xxx, AA4xxx, AA6xxx, AA2xx or AA3xx alloy.

30. A cast composite according to Claim 28, wherein the composite contains no more than 0.8 weight percent magnesium.

31. A cast composite product comprising an aluminum alloy matrix having between 10 and 40 volume percent of boron carbide refractory particles dispersed therein, wherein the aluminum alloy matrix contains at least 0.2 weight percent magnesium, the composite contains at least 0.2 weight percent titanium, and the aluminum alloy matrix has an as cast microstructure.

32. A cast composite according to Claim 31, wherein the aluminum alloy is an AA2xxx, AA3xxx, AA4xxx, AA6xxx, AA2xx or AA3xx alloy.

33. A cast composite according to Claim 31, wherein the aluminum alloy matrix contains no more than 1.4 weight percent magnesium.